# The Gardens' Bulletin

## STRAITS SETTLEMENTS

Vol. II Issued July 4th, 1919 No. 4.

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To be purchased at the Botanic Gardens, Singapore; or from Messrs. Kelly and Walsh Ltd., No. 32, Raffles Place, Singapore.

Printed at the Methodist Publishing House, Singapore.

# DEPARTMENTAL NOTICES.

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The new List of Plants, which may be purchased from the Botanic Gardens, Singapore or Penang, can be had on application.

Plants of the Avocado Alligator Pear—*Persea gratissima.*—and Brazil nut—*Bertholletia excelsa,*—to be sold within the Peninsula at fifty cents each.

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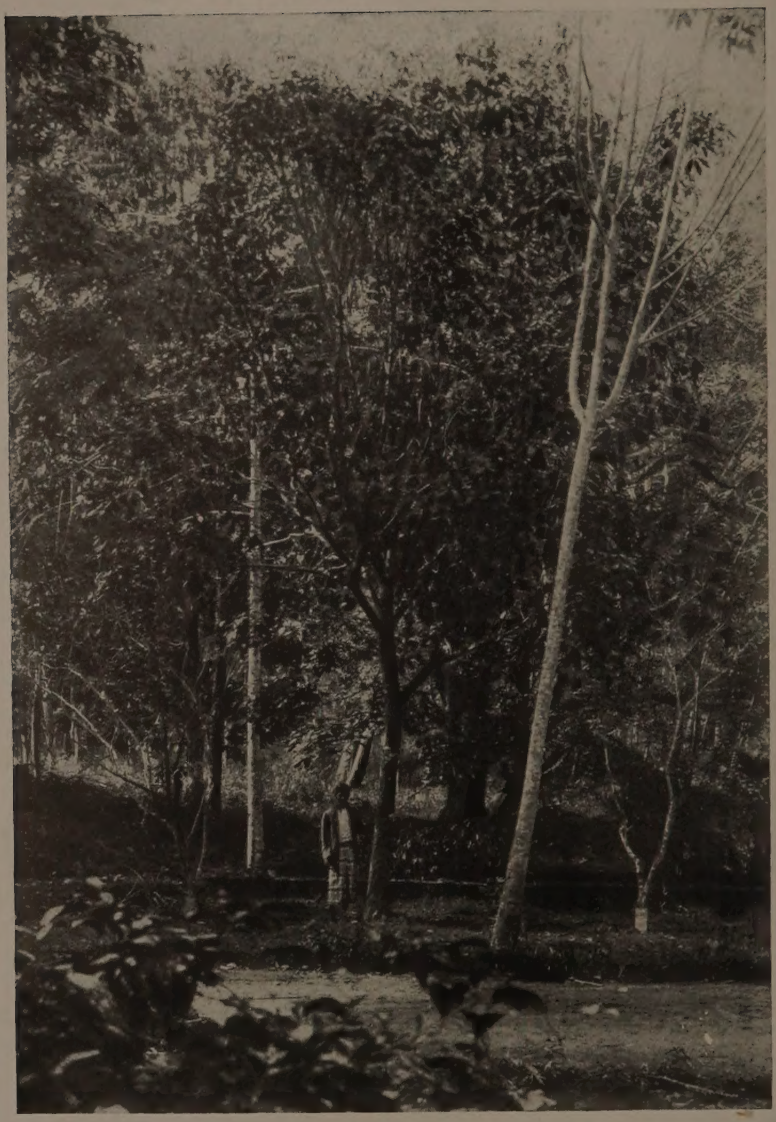
Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen shillings in Europe.



Rubber tree No. 1844, the tree with dark bark, at the foot of which the man stands.

THE

# GARDENS' BULLETIN,

## STRAITS SETTLEMENTS.

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## HEVEA *VERSUS* FUNGI.

It has long been a commonly observed fact in the history of many crops that at first, with only small and isolated plantings, there is likely to be little if any trouble with diseases and pests. This has often resulted in giving planters ill-founded hopes and false assurances as to the future. As the area planted is extended and large sections of country become occupied with the crop, endemic fungi and insects gradually become adapted to it, and others slowly filter in from abroad. The latter occurrence is quite inevitable in new countries since the people of such countries cannot be convinced of the necessity of strict plant quarantine regulations efficiently administered, until driven to it by bitter experience—too late.

*Hevea* is a conspicuous case in point. A large number of fungi have become adapted to it in oriental plantings, and so far as production alone is concerned, fungi will constitute the limiting factor. It is perfectly characteristic of human experience and human failings, that planters and government administrators cannot be expected to become fully alive to the problems involved and the necessities of the case, until staggering losses have been suffered, or until wholesale infection has occurred. It was only after the coffee industry of Ceylon and Java was doomed that effective work began in the study of the Coffee Rust. It was only after thousands of acres of fine Florida orange groves were destroyed that people awoke to the importance of the Citrus Canker, as a limiting factor in citrus culture. Verily, we are anxious enough to lock the barn after the horse is stolen! But it is not *always* thus! The U. S. Department of Agriculture now has Dr. Weston —an able pathologist—stationed for a year in the Philippines to study the highly destructive oriental corn mildew. Why should this great expense be incurred when there is no corn mildew in the United States? *Because the corn mildew is not wanted there, and because, if it should by chance get there, it may be met with full understanding!* In this manner, active work is not only being done

at home, but in all parts of the earth, for the protection, present *and future,* of American agriculture.

A great industry like rubber growing representing investments of millions of pounds should be adequately protected. This means thorough and *timely* investigation of every possible prime factor and every related subsidiary factor touching the growing of rubber. It also means the employment of a large force of active and highly trained specialists and the establishment of numerous well equipped laboratories. The Hawaiian Sugar Planters have profited extensively by such an organization. The American Rubber Company in Sumatra evidently intends to do so.

The investigation of rubber diseases has usually proceeded by certain stereotyped methods. From diseased tissue, pure cultures are started in artificial media, the resulting growths inoculated into healthy tissue and the disease reproduced. The vegetative form at least of the specific organism is thus isolated, and then attempts are made to secure the spore bearing form in pure culture, to determine its identity and to determine the original sources and methods of infection. Unless all of this can be accomplished it frequently follows that effective sanitary and remedial measures are impossible to devise. Many fungi refuse to produce their spore-bearing forms in any ordinary artificial culture. However, all of these fungi will fructify freely under certain natural conditions. The perfect form of a certain serious apple disease was not known until finally discovered on small withered and weathered apple-mummies that lay on the ground beneath the tree. Numbers of other important cases of the sort might be cited.

It follows, therefore, that there is another important avenue through which these problems should be approached, and which is usually largely neglected. *Every fungus* growing on or in connection with rubber trees *should be known and its relation to this important crop thoroughly understood.* It is commonly the case that parasitic fungi produce spore bearing forms only after the affected tissues are dead and then, frequently, only under certain natural conditions. It follows that every fungus fruiting on dead Hevea must become an object for investigation. It is not safe to overlook one! Certain forms formerly supposed to be exclusively saprophytes, living only on dead tissue, have been found, under certain circumstances to be actively parasitic. This is true of even such a common saprophyte as *Polyporus hirsutus* Pers. *Trametes badia* Bk. may be purely saprophytic, but I found it in the Botanic Gardens, Singapore, on *Saraca declinata* with its mycelium penetrating living tissue. The life histories of every fungus appearing on Hevea—living or dead, should be clearly traced. From every fungus producing spores on dead tissue, inoculations should be made into living tissue, and in many cases they will be found to take hold with definite parasitic action. If *all* were included I have no doubt that the identity of various obscure fungus diseases would be determined by this indirect method, where other methods had failed. I also have no doubt but that it would bring to light

a number of parasitic diseases not yet known to planter or plant pathologist: and this is where we would like only too well to begin our knowledge of all plant diseases.

During a recent short term of service at the Botanic Gardens, Singapore, in the heart of the oriental rubber region, I began a simple census of the fungi to be found, in fruiting forms, on Hevea. The cutting short of my stay stopped the work almost as it was begun; but the meagre results obtained have been most astounding and indicate the almost complete former neglect of this subject in a country where it should have been receiving, long since, the most intensive attention. Out of the first fourteen fungi encountered, other than Basidiomycetes, *ten were forms wholly new to science and one represented a distinct new genus!* These have been determined by Saccardo, the dean of living mycologists, (in Bull. Orto Botan. R. Univ. di Napoli, VI, (1918), 40-65), as follows:—

On dying leaves.
*Sphærella heveana* Sacc. sp. nov.

On dead limbs.
*Didymella oligospora* Sacc. sp. nov.
*Neotrotteria pulchella* Sacc. gen. and sp. nov.
*Eutypa ludibunda* Sacc. v. *heveana* Sacc. var. nov.
*Cryptovalsa microspora* Sacc. sp. nov.
*Peroneutypa heteracanthoides* Sacc. sp. nov.
*Nummularia repandoides* Fuch. var. *singaporensis* Sacc. var. nov.
*Daldinia concentrica* (Bull.) Ces. v. *escholzii* (Ehrenb.)
*Lembosia glonioidea* Sacc. sp. nov.
*Hysterium heveanum* Sacc. sp. nov.

On rotting stumps.
*Xylaria* (*Xyloglossa*) *tuberiformis* Berk.
*Xylaria* (*Xyloglossa*) *obovata* Berk.
*Xylaria* (*Xyloglossa*) *scopiformis* Mont. v. *heveana* Sacc. var. nov.

On rotting trunks.
*Pleonectria heveana* Sacc. sp. nov.

Of course it is probable that some of these are purely saprophytic, though no one *knows* anything about this. It will be recognized that a number of the genera are well known to include active and most serious parasites. On the other hand both saprophytes and parasites may be represented in one fungus genus: and usually nothing final can be said without careful investigation, since, as I have already stated, fruiting forms in dead or even rotting wood may originate from mycelia actively parasitic in living tissue.

The same spirit of inquiry should be directed toward all of the Basidiomycetes growing on Hevea. In the short time at my disposal I encountered the following on Hevea in Singapore:*

* All determined by N. Patouillard, Neuilly-sur-Marne (Seine), France.

On dead limbs.

*Favolus spathulatus* (Jungh.)
*Hexagona cervino-plumbea* Jungh.
*Hexagona pulchella* Lev.
*Hexagona thwaitesii* Berk.
*Lentinus leucochrous* Lev.
*Lopharia mirabilis* (Bk.) Pat.
*Polyporus flavus* Jungh.
*Polyporus grammocephalus* Bk.
*Trametes lachnea* Berk.
*Trametes persoonii* Mtg. forma resupinata.

On rotting stumps.

*Polyporus hirsutus* Pers.
*Polyporus rugulosus* Jungh.
*Polyporus williamsii* Merr.
*Trametes persoonii* Mtg.

It seems certain that in view of all the facts, even more rigid sanitation should be required in rubber plantations than among coconuts,—where sanitation is an effective protection against some of the most destructive pests and diseases. In a large and otherwise well managed rubber plantation on Singapore Island, where a considerable amount of thinning had been done some time before my visit, I found that the dead trunks and stumps had been left on the ground long enough to secure the development of vast numbers of fruiting bodies of a large series of fungi, thus insuring the thorough distribution through the plantation of billions of viable spores. To put the matter off by saying that most of the species are probably saprophytic is, I believe, in view of our almost entire lack of knowledge concerning them, merely "flying in the face of Fate." Our very lack of knowledge should be the soundest possible reason for the most rigidly perfect plantation sanitation! I have long been interested in fungi and have pursued the subject in many countries, but have been always hard pressed to find any time for extensive field work. Yet I have brought together extensive materials in some of the most interesting groups of the Ascomycetes, and this, too, in groups in which good spore bearing material is usually difficult to secure. Much of this has been accomplished by a method which is simplicity itself. In the forest the distribution of spores of a vast number of species is very wide, in fact, almost universal, by reason of wind and rain. Therefore I have only to cut a bundle of fagots of any known tree and expose it to normal forest conditions to secure most of the fungi naturally adapted to that special substratum, both saprophytic and parasitic. Some species fruit only on decorticated wood, some only on young twigs, others only on limbs of special sizes and degrees of maturity and still others only on trunks or leaves; and different seasons will produce different results on all these types of substrata when handled as above indicated. Finding this method of the greatest success in the forest, I began years ago to apply it in garden, field, and orchard, securing in this way very fine fruiting material of a

large number of fungi, many known to be of great economic importance. In view of all of these facts I believe that the plainest common sense will dictate the necessity of the most rigid sanitation in and near rubber plantations.

This is all a look forward. The few plant pathologists who have been privileged to work in the Peninsula have accomplished results of value which should be in no wise discounted. But the "field is so great and the hands so few" that there is no present promise of our being able to compete with nature in this matter. The natural state of the forest is not only one of superabundant life but also one of wholesale and all-pervading death. The successful upsetting of the normal plan of nature, and maintainance of health and vigor in every individual of an extensive plantation, can only come out of comprehensive, intensive, and adequately supported scientific investigation.

C. F. Baker.

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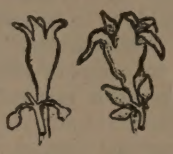
## THE GARDENS' HEVEA TREE No. 1844,—H. CONFUSA, HEMSL.

Planted in the exact centre of a small rectangular bit of ground close to the office in the Economic Garden stood a rather small rubber tree which bore the number 1844. Its dark grey bark attracted attention to it; and when it was more closely examined the foliage was seen to differ from that of the neighbouring trees of *Hevea brasiliensis*. Its history was unrecorded: but by the way in which it stood, it suggested that it came by no accident, but was set in its position as something apart from the other rubber trees.

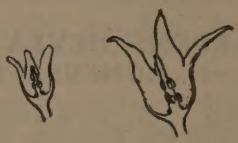
When it flowered in 1917 it was seen that the flowers removed it far from *H. brasiliensis*. The seeds also were found small, though not outside the extraordinarily wide limits in which *H. brasiliensis* varies: when it was tapped the latex was found to be yellow, meagre in amount and to remain tacky, with little elasticity. It appeared to be an undesirable type: but it was determined not to destroy it without enquiry. Flowering specimens were therefore dried and sent to the Royal Botanic Gardens, Kew, where Sir David Prain has been so good as to have it determined as *Hevea confusa*, Hemsl. The tree has now been destroyed on account of its proximity to the seed bearing trees, lest it should bring about cross-pollination; but seedlings have been raised in order that if any purpose is found for it, the species may be available.

*Hevea confusa* originates from British Guiana. It differs in so little from *H. pauciflora*, Muell. Arg., of the same region that to unite the two on botanical eye characters is quite justified; and if united, it takes the second name. Seeds of the tree 1844 had been sent to Dr. P. S. Cramer before flowers could be sent to Kew; and with no more material than this he had suggested *H. pauciflora*

as the species. It belongs to the section of the genus which has the male flower-buds blunt, as the annexed figure shows, whereas in *H. brasiliensis* they are acute. The female flowers of *H. confusa* are further a little smaller and the male flowers considerably smaller than in *H. brasiliensis.** But a still more striking difference is in the pose of the male flowers.



On the left a female flower of *H. confusa* with buds of two male flowers (a third has been broken off). On the right a female flower of *H. brasiliensis* and three male buds. Note the smaller flowers of the first and that the male buds bend earthwards.



On the left a male flower of *H. confusa* in section and on the right a large one of *H. brasiliensis* which is very variable in regrad to size of its male flowers. Note the blunt perianth lobes of the first.

The panicle in *H. brasiliensis* carries up to 300 flowers of which, always if well developed, the terminal flower is female; and the better developed the more female flowers are there, terminating the stronger lower branches, up to about 7 in number. Thus a panicle that is weak may be wholly male, and the stronger and larger it is, the more in number are the female flowers on it. All these female flowers take their position as regards the earth from the axis that they terminate, and that position is generally in some measure such that they are directed upwards or obliquely upwards: but the divergence of this angle from the vertical is determined by the angle at which the branch takes off from its parent axis and again this by the angle at which the parent axis stands: The panicles produced by tree No. 1844—*H. confusa*—are narrower than those of *H. brasiliensis,* as much because the angle at which the side axes take off is smaller, as because, at least in tree 1844, they are of lesser size. The weakest panicles are wholly male as in *H. brasiliensis,* and the stronger carry more and more female flowers upon the lower side-branches up to 5 or 6.

* J. Huber, Novas contribuicoes para o genero Hevea in *Boletim do Museu Goeldi*, vii, 1910, pp. 200-216, has discussed at some length the size of the flower. as a character by which species and groups of species may be distinguished f om each other.

The perianth of the female flower in *H. brasiliensis* is of a dull mustard yellow, and if normal consists of five ovate acuminate sepals coherent in their lower third into a cup, which is of a greener tint inside than the lobes. This cup is almost filled by the ovary, around the base of which is a slight circular swelling being the disc which may be just damp with honey; five slight thickenings extend up the cup as the midribs of each part of it. In *H. confusa*, the perianth lobes are ovate and blunt, and the cup extends to half their length; they and the cup are straw-coloured with a magenta line down the middle from the tip or near it to the very base inside. Outside they are covered with short hair. The top of the ovary is conspicuously blunt with sessile stigmas.

Often in *H. brasiliensis* the first flower of a panicle to open is a male flower; but after all the female flowers are over, there are males that follow in considerable numbers. The male of *H. brasiliensis* is like the female in perianth, but smaller and hardly pale green within the cup. The staminal column carries two rings of five anthers. The pose of the flower depends upon the axis which bears it, and it may face in any direction. The male flowers of *H. confusa*, like its female flowers, are smaller than those of *H. brasiliensis*, blunter, different in colour, being straw-coloured: they have fewer anthers, and by the bending of their pedicels they face more or less earthwards. Outside they are hairy. This bending of the pedicels gives a very good distinguishing mark which the herbarium student cannot note so well as the field student.

The seeds are as figured by Hemsley in *Hooker's Icones Plantarum*, plate 2575: but tree No. 1844 gave flowers with blunter perianth-lobes than the figures on plate 2574.

*Hevea pauciflora* is known to produce hybrids with *H. brasiliensis*, and so far it seems that these hybrids have no value.

A sample of rubber from the tree was submitted to Dr. Frankland Dent, Government Analyst, Straits Settlements, and another to the Director of Agriculture, F. M. S., for kind submission to Mr. B. J. Eaton, Agricultural Chemist in the Department of Agriculture. These two samples on analysis scarcely differed: they contained about 95 per cent of a substance chemically rubber but lacking the physical properties required in commercial rubber, probably as Mr. Eaton suggested a polymer of caoutchouc; and they contained also rather under 2 per cent of resins. The samples were too small for a vulcanization test. They were small because the tree yielded so grudgingly.

I. H. Burkill.

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## MANGO PESTS IN SINGAPORE.

In no other part of the tropics are mangoes more badly pest-ridden than in Singapore. Locally produced fruit is therefore neither abundant nor of good quality. There is nothing in Singapore to compare with the great quantities of fine "carabao" man-

goes produced in the Philippines. It would be a catastrophe immeasurable if the mango pests of Singapore were introduced into the Philippines.

Among the mango pests of Singapore, three are very conspicuous, one insect—a psyllid,—and two fungi. The psyllid produces a leaf gall the size of a small pea, and these are sometimes so numerous as to occupy a large part of the surface of the leaf. When the insect is mature, the gall splits open at the top, the acute segments recurving. These insects secrete considerable quantities of honey-dew, and this may account for the astonishing growths on the same and neighbouring leaves of a sooty black fungus, *Meliola mangiferae* Earle. This fungus was described from Porto Rico but has been found to be practically pantropical in distribution. Between the psyllid and the fungus, the leaf has little chance of performing its natural function.

Certain trees which have escaped the psyllid and the *Meliola* may have practically every leaf scattered thickly with the small reddish brown nodules of an extremely serious fungus pest, *Zimmermanniella trispora* P. Henn., and under this load the leaf soon dies and falls.

The investigation of these pests should proceed from two points, first beginning with the psyllid, and second to determine the degree of parasitism in the *Zimmermanniella*. It is entirely probable that remedies can be devised to control these and keep the trees clean and healthy.

C. F. Baker.

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## FUNGI FROM SINGAPORE AND ALSO FROM PENANG.

"Fungi Singaporenses Bakeriani."

[The following enumeration is of fungi, collected with two exceptions, by Professor C. F. Baker during his short service with the Government of the Straits Settlements: and enumerated by Prof. Saccardo in the Bulletino del Orto Botanico Reale di Napoli, Vol. VI, (1918) at the pages given after each name. In the Journal of the Royal Asiatic Society, Straits Branch, No. 78, 1918, pp. 67-72, will be found descriptions of sixteen others under the title of *Some Singapore Boletinae*—a joint paper by M. N. Patouillard and Prof. C. F. Baker: and again in the Bulletin de la Société Mycologique de France XXXIV, 2e fasc. is described by M. Patouillard a further fungus *Echinodia Theobromae* from dead Cacao branches in Singapore.] Ed.

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(89 species and varieties, 67 *new*.)

## ACCLIMATISATION TRIALS OF LIMA BEANS

### (Phaseolus lunatus).

The following varieties of Lima beans were received from Philadelphia U. S. A. on 23rd July, 1918:

No. 1. Siebert's Early.
" 2. Purple improved bush.
" 3. Small Lima or Sieva pole.
" 4. Dreer's Wonder bush.
" 5. Fordham's bush.
" 6. King of the Garden.
" 7. Dreer's improved pole.
" 8. Henderson's bush.

On 31st July, 8 beds, 18 feet by 3½ feet numbered 1 to 8, and labelled, were, after a preliminary liming, sown with 28 seeds of each variety, one for each bed. The soil had been previously manured and had given a crop of maize.

*Bed No. 2* showed no sign of germination, a second sowing, and a trial in pots gave a like result.

*Bed No. 7* gave only 6 germinations with shrivelled leaves of no vitality. A second sowing gave nothing. The two beds were dug up.

During August and September, the remaining six beds were kept weeded, and stirred, each plant receiving a light earthing up.

In the records kept, the growth of the beds is set down as follows:

#### No. 1. Siebert's Early.

*30th September.* "The plants have come up very strong—a strong climber, with heavy foliage and a fair show of flowers. A sparse crop of broad pods 3½ to 4 inches long, with a kink at the tip—with two or three beans per pod, which, I fear, will not develop to full-size seed."

*15th October.* (76 days from sowing), four mature pods were plucked, but only two beans were found fit for seed.

#### No. 3. Small Lima or Sieva Pole.

*30th September.* A thriving plant; a strong and healthy climber, by far the best of all the Limas. Very heavy foliage with abundance of small pods 2 to 3 inches long, ½ inch broad. Not attacked by white fungus, which is prevalent on neighbouring beds. In this case, as in No. 1, the foliage was so dense that it had to be thinned down, and the stakes had to be braced to support the weight. The excessive flowering had also to be checked by pinching back the tops—which also tends to strengthen growth below.

#### No. 4. Dreer's Wonder Bush.

*30th September.* As its name implies, does not climb. Only a few beans are showing: they are very broad (one inch) with a pronounced kink at the tip. Spots of rust are noticeable on many pods.

No. 5. Fordham's Bush.

*30th September.* Abundant flowering, but no pods formed as yet.

No. 6. King of the Garden.

*30th September.* A climber, but a weak and unhealthy-looking plant. A very few pods are visible of the very broad kind, 4 inches long.

*15 October.* This bed is now showing a fair number of pods some of which measure 5 inches in length: but many are flat containing no seed, or abortive seed.

No. 8. Henderson's Bush.

A squat, leafy bush with a number of small pods, eight on the average, to each bush: the pods, 2 to 3 inches long, contain mostly 3 seeds. It seems to resist the white fungus which has killed many plants on beds Nos. 5 and 6. This bean is, after No. 3 Small Lima or Sieva Pole, the most promising of the Limas. Yet a second bed, sown on 16th September on a previous ground-nut plot, had failed.

As mentioned, a fungus, taking the form of a white hoar-frost, particularly visible in the early mornings, or after rain, along the lower parts of the stems, had attacked the vines in all the beds except numbers 1, 3 and 8: its effect was deadly on the plants attacked, which gradually dried up and decayed.

All the Limas, except Nos. 1, 3 and 8 were therefore dug up and eliminated from this trial.

The progress of these 3 beds is recorded at length in the Journal; but in order not to unduly extend these notes, No. 1 Siebert's Early may be at once eliminated as a failure, for although it is still growing in the garden, it seeds sparsely and the pods are badly filled.

No. 3. Small Lima or Sieva Pole.

A remarkably prolific vine, without, so far, trace of rust, or of the fungus which has attacked the other beds, and which, after microscopic examination, was identified by Mr. Deshmukh as *Colletotrichum lindemuthianum.*

*October 9th.* (70 days from date of sowing) plucked a few pods, which gave 16 fairly large, flattish beans which were, soon after, planted on a separate bed.

*October 10th.* The foliage is so thick that it has to be thinned for the second time, to allow at least a partial access of the sun to the pods.

*October 14th,* 75 days from date of sowing, collected 70 pods which gave 151 beans, of which 110 were selected for seed.

*October 15th to 23rd,* the following crop was gathered in daily pickings:

546 pods yielding 1187 beans, of which 814 were selected for seed.

*October 24th to 9th November,* the following crop was gathered. 255 pods yielding 583 beans, of which 309 were kept for seed.

*After 9th November,* a large number of pods were picked, but many were found to be empty, or with abortive seeds, or in some cases, germination had already started within the pods. The fungus referred to above had now attacked this bed also, and none of the beans, from that date, were kept for seed.

So far, then, from 14th October when cropping began, to 9th November (*i.e.* from 75 to 101 days from date of sowing) the nett result of the crop was:

871 pods yielding 1921 beans of which 1233 (*i.e.* 64%) were kept for seed. This was obtained from 28 seeds sown at the origin, on the 31st July, 1918, and corresponds to a yield of 31 pods and 68 beans for every seed sown.

*November 15th.* There are still a number of pods on the plants but they are all, more or less, badly infested with maggots, and very few are fit, even, to eat. The bed is to be dug up. (The bed was not dug up as explained below).

It may here be mentioned that the shells of the Lima bean are quite uneatable, but the bean itself affords a quite excellent dish.

The Lima is, I believe, not much thought of in Europe. Decaisne does not recommend it: but it is held in high estimation in America.

If personal taste may find expression here, the writer's opinion is that the bean is equal to the best French Soissons: it is farinaceous and melting in the mouth—and, in every way, most palateable.

### Second Generation.

Of the 1233 beans originally selected for seed, 556 had been sown in 15 beds on the 24th October, 1918; but there were many failures, and, on examining the remainder of the selected seeds, the reason of these failures was revealed. It was found that, by keeping, many of the beans selected as perfect for seed, developed defects, which were not, at first, apparent in the fresh beans. Small specks would appear under the skin of the beans, generally on or near the rim, sometimes also round the eyes, which specks very soon developed into a cancerous growth right through the whole substance of the beans; and, a few days after the sowing of such beans, it was found that, on opening, the two cotyledons were eaten through and through with rot.

This showed the necessity of keeping the beans for sometime before sowing, to give time for the disease to reveal itself, and, henceforth, all the beans underwent at least ten days' drying, during which a second and a third selection was gone through. The drying of the beans must take place in the shade, for the skin of the Lima is not thick, and if put out in the hot sun, the skins are apt to crack.

The failures of the previous sowing were made good, to their original number, namely 556, but of these a good 15 per cent was destroyed, partly by minute larvae, *Melolonthids*, introduced into the soil by immature cowdung, partly by night insects which nip the stems clean off.

The crop, as recorded, day by day, in the Journal, was therefore obtained from about 470 beans of the second generation.

The pickings, begun on 6th January, 1919 were stopped on the 31st March and the result to-date (12th April) is as follows:—

| | | | |
|---|---|---|---|
| Number of pods picked .. | 11174 | | oz. |
| Perfect beans selected for seed | 9294 | weighing | 269¾ |
| Imperfect beans but eatable .. | 5228 | „ | 77¼ |
| Uneatable, diseased, maggotty, etc. .. | .. | .. | 38½ |

470 plants have therefore given, so far:

11174 pods containing 14522 beans weighing 347 oz. or 24 pods and 30 beans for each seed put in the ground. As the crop is only half way through, no final figures can be given at present. Pending the early resumption of plucking, the beds are receiving a light hoeing and a mulch of fallen leaves, and prunings of the dead stems.

Before passing on to the record of the new crop *i.e.* that of the third generation now begun, it should be here mentioned that, under local conditions, the Lima bean becomes perennial, that is to say growth is continuous and, on the same plant, may be seen, at the same time, mature and immature pods, and flowers.

In Burmah, where the Lima bean is cultivated as a field crop, the same perennial habit of the plant has been observed by Mr. van Buren (Tropical Agriculturist, June, 1918).

The original bed, sown on 31st July, 1918, which, as previously stated, it was decided to dig up (but which for some reason was not dug up) is still giving crop, and at date of writing, new racemes of flowers are opening (255 days from date of planting).

At first thought, this continuity of growth would appear to be an advantage. The writer himself took it to be so, and seeing the bed put forth new flowers, it was manured and, in due course, new crops of beans came on. But it is a question whether it is not the more profitable course, after the main crops have been taken, to root up the plants, and put the beds to some other cultivation which will get the benefit of the improved soil brought about by the bean cultivation; or again, if the crop is to be beans, whether it is not the better course to dig up the old vines, enfeebled by previous crops, and replant with fresh seed.

In both cases, a thorough tillage of the soil will be necessary, with an application of manure, and there will be no saving on that head, while the crops of the new planting will, I believe, be much greater than if the old plants are allowed to "carry on" as perennials.

There are moreover, other reasons which tend to militate against perennial cultivation of the Lima bean.

The Lima bean has the well deserved reputation of being a very robust plant, branching profusely, and carrying a very dense foliage. If left to grow as a perennial, the beds form a tangle of stems, of branches and leaves, old and new, which it is almost impossible to keep in trim, and if any insect pest or fungoid disease descends on the beds, it is very difficult to cope with. Should moreover, the weather be very wet, which was the case here, these pests take such a hold on the old plants, that on a field scale, many would be killed. It was possible, dealing with only one bed, to keep the disease, anthracnose, in check, but even then, it was only by dint of frequent sprayings that the crop could be saved, and that only partially.

Another effect of the prolonged stay of the plants in the ground, is that, unless the poles, on which the vines are trained, are of wood which resists the wet, they are liable to rot and break down after some months, and it is no easy matter to prop up again in anything like order, the resulting medley of broken sticks and tangled stems.

This last remark does not apply to the case of field cultivation as practiced in Burma where the plants are not grown on poles but left to trail on the ground.

Lastly, the crops fall off, on the old beds, and they are not equal to those obtained from newly planted beds.

### Third Generation.

From selected seeds of the second generation accounted for in the preceding pages, which seeds were submitted to further selection after trial in pots, 15 beds were planted with 455 seeds. The planting, begun on 11th January, was finished on the 25th of the same month 1919. It was limited by want of suitable land.

### Crops Obtained from 3rd Generation.

| | | | | | |
|---|---|---|---|---|---|
| 1st to 5th April | 548 | pods gave | 968 | perfect beans weighing | 22 oz. |
| 7th to 9th „ | 958 | „ | 2114 | „ „ | 48½ oz. |
| 11th „ | 1173 | „ | 2740 | „ „ | 67 oz. |
| Totals to date | 2679 | „ | 5822 | „ „ | 137½ oz. |

These figures show, at a glance, a marked improvement on the previous crop and this is brought strongly in evidence if the results of the two crops are put side by side: the figures stand as follows:—

| Number of pods. | Perfect beans Weight. | Imperfect beans Weight. | Uneatable Weight. |
|---|---|---|---|
| 2nd Generation 11174 | 4294—269¾ oz. | 5228—77¼ oz. | 28½ oz. |
| 3rd Generation 2679 | 5822—137½ oz. | None. | 2¾ oz. |

In the first crop, each pod contained only 1.3 of beans, whereas in the second crop each pod contains 2.1 beans.

The first crop had 5228 imperfect beans; imperfect in appearance, in shape and colour, defects which, while not rendering them uneatable, would certainly detract of their marketable value. The second crop, although it was examined with greater closeness than the previous one, had not one such bean.

Of beans uneatable, maggotty, etc., the first crop had 38½ ounces for a total weight of 337 ounces or 11 per cent. the second crop had 2.36 for a total weight of 137½ oz. or 1.70 per cent.

Again, if we compare the weights of the two crops we find:
2nd Generation 14522 beans weighing 337 oz. or 2.32% beans.
3rd „ 5822 „ 137½ oz. „ 2.36% „

The greatly improved quality of the beans of the latter generation is attributable to better weather conditions, secondly to absence, so far, of fungoid disease, and thirdly to more severe selection of the seeds which, one by one, underwent three sortings before sowing.

### The Mature Bean.

The pod of the Lima bean, when approaching maturity, is, at first, of a bright yellow colour, which turns in one day or at the most in two, to a true khaki colour; at this stage, the beans are loose from the shell and, on shaking the pod, are heard to rattle inside. Then, is the time to pick them: if picking is delayed, dehiscence takes place and the beans may fall to the ground. The pods which, at maturity, are not of a true khaki colour, but which show streaks of brown or purple, or which are mottled green and brown, have almost invariably damaged beans, the stains being due to the decomposed state of the beans brought about by maggots or to the cancerous condition induced by *Colletotrichum lindemuthianum*.

The beans selected for seed should be pure white—opaque—not glossy but "mat" to use the French term. Any beans which, after keeping for a week, show a shrivelled skin or any discoloration whatever, or which take a semi-transparent hue, should be discarded: but such beans may be perfectly good to eat.

The beans selected for seed should be firm to the feel, and hard under the nail.

The diversity and irregularity of shape, and of size of the Lima beans has perhaps contributed, as much as anything else, to prevent their more general acceptance in Europe, for this uneven ness necessitates a rather troublesome sorting before marketing. For that reason, some care should be given to this matter of shape in the selection of the beans for seed, with a view to attain a type of true kidney-shape. The two predominating contours, I find, are the boomerang-shape, (but full on the inside) with a rather sharp apex—and the kidney-shape of the ordinary garden bean, but with the inside curve less pronounced.

The boomerang-shaped bean is almost always flat and large; the kidney-shaped is less large but it is rounder, plumper, fuller.

For that reason, given two beans of sound quality and of about the same weight, one of the boomerang-shape, the other of the kidney-shape, the writer would choose in preference, for sowing purposes, the latter one, even if somewhat smaller in size. Time will show whether the type breeds true.

The importance of a severe selection of seeds is very soon realised by planting this bean. From 60 per cent of germinations obtained in previous sowings, the latest sowings in the gardens commonly show from 90 per cent and upward of germinations.

Another very common feature in Lima beans are the striations converging from the rim to the hilum (eye).

These striations, much more marked on some beans than on others, are due to a tendency to reversion to the original red or purple coloured type. Seeds showing that character in a marked degree should be rejected for planting purposes, the purple coloured type containing, it is said, prussic acid.

If the beans are not destined to be planted, but merely for table use, their character may differ, in some cases, very widely, from the description just given. In the first place, the pods should be picked when they are of a light yellow colour, without waiting for the shell to turn to khaki colour. The beans themselves, instead of dead white, may be glossy, and the converging striations do not matter. Lastly, the shape is also of secondary importance although it affects the market value to some extent.

The Bulletin of the Imperial Institute (Vol. 15, No. 4) contains interesting reading on the subject of the Lima Bean or "Rangoon white bean." The following figures speak for themselves:

"Forms of *Phaseolus lunatus* are largely grown in Burma. "The two most common forms grown in Burma are the red-seeded "and the white-seeded kinds."

"In Burma, *Phaseolus lunatus,* is a favourite crop for field "cultivation, 240,000 acres being devoted to the white variety, "and 94,000 acres to the red variety in 1916-1917."

"The quantities and values of pulse, including peas, exported "overseas from the Province during 1916-1917 were: 1,439,000 "cwt. value £791,208."

"Of these quantities, 1,138,000 cwt. were exported to the "United Kingdom."

The large shipments to Peninsular India are not included in the above.

"Seeds are usually dropped into furrows in rows about 1 "to 1½ ft. apart: they are also sometimes broad-casted, mixed "with maize, and are covered with soil by harrowing. When sown "with maize, the stems of the maize plants serve as supports to "the trailing stems of the beans, but when sown alone, the stems "are allowed to trail over the ground. The crop generally takes "five months to mature."

The writer has tried experimentally the planting of Lima beans with maize; but the result was somewhat disastrous, both

the maize and the beans giving returns much below the average; but the chief objection to this mixed planting is that, in twining themselves round the maize stems, the bean stems strangle the maize cobs and arrest their development.

In other respects, also, the practice followed by the writer differed widely from the above.

First of all, the seeds were not sown broad-cast or dropped in furrows, but each bean was sown separately, the most advantageous distances being found to be 20 inches on rows one foot apart with 3 such rows per bed.

Secondly, the plants were not left to trail on the ground but were supported by poles, 4 poles for each 12 plants with transverse sticks on top. Planted on such lines as are here indicated, one acre of land affords room for 250 beds 30 feet long by 3½ feet wide with alleyways, each bed accommodating 45 plants in 3 rows of 15, at the distances specified above. Thus, one acre would accommodate about 11,000 plants, of which 10,000, under favourable conditions (well selected seeds and careful watching for pests) could be expected to reach maturity in three months, and to yield an average of two ounces of beans per plant, resulting in a crop of 1,250 pounds of beans.

It is impossible to draw up an estimate of the cost of a crop of beans to fit all conditions. But, given agricultural land under normal conditions, cleared of jungle and stumps, a land, say, of light secondary growth, which can be cleared and drained at small cost: a land, which can be got ready for the plow, or the changkol at a cost, say, of $20 per acre—then the expenditure could be figured as follows, for one acre:

| | |
|---|---|
| Clearing and draining .. .. .. .. | $20.00 |
| Labour: changkoling, raking and earthing up 1½ coolies for 3 months at $15 .. .. .. .. | 67.50 |
| Seed beans, 16 pounds (selected) at $0.40 .. .. | 6.40 |
| 4,000 stakes at ½ cent .. .. .. .. | 20.00 |
| Fungicides and insecticides .. .. .. .. | 10.00 |
| Tools and appliances .. .. .. .. | 8.00 |
| Superintendence .. .. .. .. .. | 5.00 |
| Estimated expenditure .. .. | $136.90 |

If the plow is used instead of the changkol, the labour bill would be reduced by about $18.

The subsequent crops would cost less by about $50 but, if the soil is a poor one, manuring would have to be done at a cost of $25 to $30.

The planter would have the option, also, of leaving his crop on as a perennial, or of digging up and re-planting.

Good lallang land might very profitably be put under a bean crop, for it should be observed that by its heavy foliage, the bean supplies a dense cover and, during the 3 months which the crop demands, the lallang will be kept under.

Referring again to the above extract from the Bulletin of the Imperial Institute, it is there stated that the bean crop in Burma takes 5 months to mature.

As a matter of fact, with three successive crops, the writer has found that the crops mature in between 75 to 85 days and the pickings are heaviest between 90 and 100 days.

This is attributable, in the writer's opinion, to the fact that the plants were grown on stakes and not left to trail on the ground, as is the case in Burma. The beans grown on stakes are more open to the action of the air and sun, and the maturing of the pods is therefore much more rapid.

The results amply justify the extra expense of buying and putting up the stakes and, moreover, the beds are better accessible and, in case of outbreak of disease it is much easier to watch and to keep in check. The stakes themselves serve, to a certain extent, to guard the crop against fungus and insects by a smearing of them with strong Bordeaux mixture made adhesive by the addition of treacle, or sago.

Before closing these notes the writer would call attention to the fact that as shown by the crop records given above, three crops were obtained from the 31st July, 1918 to the 12th April, (date of writing) and that the fourth crop now partly planted or being planted, should, if all goes as in the past, be ready for harvesting by the 12th of July *i.e.* four crops in less than one year from the planting of the first crop.

### Conclusions.

Whether due to absence of fungus, or to more severe selection of the seed used, or to better weather conditions, the improved quality of the Lima bean at present being harvested is manifest, and it bears proof that the bean has not suffered degeneration through change of climate and of habitat, and it may now be considered as definitely acclimatised.

E. Mathieu.

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## A PROGRESS REPORT ON THE CULTIVATION OF THE GREATER YAM, DIOSCOREA ALATA—IN THE BOTANIC GARDENS, SINGAPORE.

When reporting upon the cultivation of the Greater Yam in the Botanic Gardens, Singapore, in 1917, attention was called to the circumstance that the plants had been grown spaced 3 by 2 feet, and that in competition between each other at such a distance they had produced smaller tubers than in the earlier years. But space forbad again in 1918 that the distances between them should be increased, and consequently the yields of 1816, for instance, were not attained. Moreover there was not available quite so much manure; and the want of it has also had an effect. The 1918 crop was consequently less abundant than the crops of 1916 and 1917.

The number of races grown together on the ground was 93. The average yield was 3.77 lbs. (1712 grammes) per hill. In the following table the three years are compared:—

DIOSCOREA ALATA, THE GREATER YAM, RACES NOT REQUIRING EARTHING UP.

| Year | 1916. | 1917. | 1918. |
|---|---|---|---|
| No. of hills ... | 582 | 520 | 299 |
| Area occupied ... | 11,330 sq. feet | 3,120 sq. feet | 1,794 sq. ft. |
| being | | | |
| an area ... | .260 | .072 | .041 |
| of a hectaire ... | .105 | .029 | .017 |
| Number of sets | | | |
| which grew ... | .559 | 424 | 273 |
| which failed ... | 23 | 84 | 26 |
| Return | 1,810,076 grs.<br>3,969 lbs. | 961,117 grs.<br>2,118 lbs. | 467,814 grs.<br>1,030 lbs. |
| Yield | | | |
| per acre ... | 6.89 tons | 13.16 tons | 11.21 tons |
| per hectaire ... | 17.239 kilos | 33,142 kilos | 27,489 kilos |
| Average yield per hill | | | |
| *i. e.* failures included | 3.110 grammes<br>6.83 lbs. | 1,849 grs.<br>4,07 lbs. | 1,563 grs.<br>3.44 lbs. |
| Average yield per plant | | | |
| which grew | 3,238 grammes<br>7.14 lbs. | 2,267 grs.<br>4,99 lbs. | 1,712 grs.<br>3.77 lbs. |

It is considered that the time has come to discard a large number of the races which have been grown. It is scarcely necessary to give any account of them, for it would serve no useful purpose to do so: they are no longer of much interest. But it will be useful to record the reasons why others have been kept; and this will be done next.

Thirteen races have for the past three years of careful competitive trials, year by year, yielded more than the average. Eleven of these thirteen have been kept, the race No. 132 being discarded as too similar to the race 76 to be required, and the race 140 as too near to the race 128. The eleven retained are:—

| Gardens No. | Origin. | Name under which received. | Figured. |
|---|---|---|---|
| 22 | Philippines. | Ubi, white, No. 1031 | G.B.II No. 2 pl.i. |
| 44 | do. | Ubi, red, No. 1025 | do. pl. ii |
| 50 | do. | White Bohol | Philip Agric. III p. 207, fig. 17 |
| 52 | do. | ——— | ——— |
| 64 | do. | No. 1040 | ——— |
| 66 | do. | Ubi, white, No. 1046 | ——— |
| 76 | do. | Sinanto | G.B.I No. 11-12, pl 2, and II No. 2 pl. i an |
| 100 | Saigon | Khoai noc trang | ——— |
| 128 | Sylhet, India | No. 35630 | ——— |
| 170 | Port Darwin, N. Australia | ——— | G.B.I. Nos. 11-12 pl. iv. |
| 192 | Gold Coast. | Eururuka nkakyi | G.B. II. No. 2 pl,i |

These differ greatly among themselves, for instance:—

| | |
|---|---|
| Magenta sap at all depths in races | Nos. 100, 128. |
| „ under the skin only | Nos. 22, 44, 140, 170, 192. |
| „ not present .. | Nos. 50, 52, 64, 66, 76. |
| Tubers branched distinctly in races | Nos. 44, 100, 170. |
| „ lobed rather than branched | Nos. 22, 50, 52, 64, 66, 192. |
| „ neither lobed nor branched | Nos. 76, 128. |
| „ flattened in races .. .. | Nos. 22, 44, 50, 52, 64, 66, 100, 170. |
| „ not flattened .. .. | Nos. 76, 128, 192. |

It may be noted that the races with flattened tubers which yield heavily, are in all cases either lobed or branched:

And again it may be noted that none of the long deep going yams are among these races.

In foliage the above eleven varied greatly. No. 76 has a prickly stem.

No. 50 is a yam that has been cultivated for three seasons in the garden of Mr. G. P. Owen, in Singapore; and in the first of them he obtained a tuber weighing 26 lbs. He gave sets from it to Mr. W. E. Hooper who obtained a still larger tuber with a girth of 52 inches and also to Dr. W. F. Samuels who at Tanjong Rambutan, Perak, also got large tubers.

It is believed that the following promise a yield of more than the average, but did not give it because of some mischance: therefore they have been retained as if heavy yielders along with those enumerated above. The mischance is the case of No. 102 was due to the necessity of interrupting the growth of the tubers, in the first season of trial before their time was complete, in order to bring them into the same period of growth as the others; and in the case of No. 10 the mischance arose from thefts: in the case of all the other, the start in 1916 was with undersized sets.

| Gardens No. | Origin. | Name under which received. | Figured. |
|---|---|---|---|
| 10 | Philippines | Tugui, finger shaped No. 1057 | G.B. I. No. 9 fig. 2 on p. 299. |
| 48 | do. | No. 2712 | — |
| 60 | do. | Kinampay ubi | — |
| 102 | Saigon | Khoai mo. | — |
| 166 | Fiji | No. 20705 | — |

The relation of these to the average (as 100) in the successive years was:

| No. | 1916. | 1917. | 1918. |
|---|---|---|---|
| 10 | 183.23 | 97.13 | 22.14 |
| 48 | 57.78 | 84.61 | 125.00 |
| 60 | 60.41 | 88.97 | 165.36 |
| 102 | 39.41 | 69.17 | 158.12 |
| 166 | 14.89 | 80.90 | 104.21 |

These five, like the eleven proved heavy yielders enumerated above, vary greatly among themselves. Two have magenta sap at all depths (Nos. 10 and 60), two have it under the skin only (Nos. 102 and 166); while No. 48 is without it. One of them (No. 60) is branched, the others being for the most part neither branched nor lobed.

So far, then, the total number of races, out of the 93 grown in 1918, which have been retained for further cultivation, upon their yield, is sixteen. Selection beyond this has been done upon other characters. In the first place it has been deemed well to keep a few of the very deep going races, because they appear to be among the most excellent for the table; it seems that the cultivators find the compensation for the labour of digging them, in the eating of them. Six have been retained, being:—

| Gardens No. | Origin. | Name under received which | Figured. |
|---|---|---|---|
| 30 | Philippines | Ubag No. 960 | G.B. I fig. 12 on p. 301 |
| 54 | do. | No. 1044 | ——— |
| 68 | do. | No. 1692 | G.B. I Nos. 11-12 plate ii |
| 108 | Fiji | No. 20693 | ——— |
| 118 | do. | No. 20710 | G. B. vol. I Nos. 11-12 Plate i |
| 186 | Assam, India | No. 35575 | do. |

Nos. 30 and 68 give tubers among the longest which have been cultivated: both appear to be very good table yams, and both have a tendency to produce twin tubers. Nos. 108 and 118 give tubers somewhat more clavate, No. 118 having magenta sap, but not so No. 108. No. 118 is certainly a good table yam. Both, and also No. 54 have very delicate skins, which bruise easily. The shape of the tuber of No. 54 is clumsy and so also is that of No. 186: and both have been retained with some hesitation.

It is well known that, for instance, there is no sale in many markets for oversized lemons. So too many markets take up small neat yams better than large yams: and with the intention of trying to meet such a case it had seemed well to retain two races of the Greater Yam which are noteworthy for the smallness, and neatness of their tubers. They are:—

| Gardens No. | Origin. | Name under which received. | Figured. |
|---|---|---|---|
| 6 | Singapore | Ubi merah | G.B. I No. 11-12 plate iii |
| 70 | Careline islands | No. 3793 | do. plate ii |

They are very unlike each other, and indeed have nothing in common except shape. The ubi merah is well established in the Malay Peninsula, and can easily be got in the Singapore markets. Chinamen grow it about Klang: and it has been seen on sale as far away as Rangoon, near which assuredly it is cultivated. It has an extremely delicate skin which is always bruised before it reaches the market and then the intensely coloured sap below it is very noticeable. Possibly the delicacy of its surface accounts for the circumstance that in 1916 it was badly attacked by white ants in the yam beds in the Botanic Gardens. So far the impression is that it is not a really good table yam.

No. 70 on the other hand has a firm surface, and keeps well in store. It is altogether without magenta sap, and seems to be a good table yam. In foliage it is quite unlike No. 6.

Five lobulate yams have been kept in addition to the heavy yielding races of that class,—Nos. 22, 50, 52, 64, 66 and 192, also one branched yam in addition to the heavy yielding Nos. 44, 100 and 170. These six are, No. 98 being the branched yam:—

| Gardens No | Origin. | Name under which received. | Figured. |
|---|---|---|---|
| 40 | Philippines | Ubi from La Union, No. 943 | — |
| 56 | do. | Dinogo, No. 965 | — |
| 62 | do. | Ubi long. No. 1023 | — |
| 78 | do. | Ubi, No 938 | G.B. II Nos. 2 plate iii |
| 94 | Guam | — | — |
| 98 | Saigon | Khoai Siam | G.B. I Nos. 11-12, plate iv. |

Nos. 40 and 62 yielded more than the average in 1916 and 1917, but less than the average in 1918:

Nos. 78 and 98 yielded more than the average in 1916, but not afterwards. Because they seem to have good keeping qualities they have been retained for further cultivation, and especially to observe their behaviour comparatively in store. No. 56 also appears to have keeping qualities; but its yield has never yet exceeded the average yield. No. 94 has been kept for a little further study as the best in yield of the yams received from Guam island.

Finally as not yet studied adequately the following have been kept:—

| Gardens No. | Origin. | Name under which received. | Figured none |
|---|---|---|---|
| 350 | S. Nigeria | Ewura | |
| 366 | Gold Coast | — | |
| 368 | do. | — | |
| 388 † | Nigeria | Adjugo kwami | |
| 390 † | do. | do. | |
| 406 | Philippines | Found mixed with No.60 | |
| 408 † | Saigon | Selected from Khoai Siam No. 98 in 1917 | |
| 410 | Philippines | Selected from No. 52 in 1917 | |
| 436 * | Papua | Makoda (*a*) | |
| 438 * | do. | Makoda (*b*) | |
| 440 * | do. | Moiva | |
| 444 | Klang, Selangor | — | |
| 448 | do. | — | |

Those marked with an asterisk above are being grown apart from the rest, for it has not been possible to bring them into the same series with the main crop, as the season at which they were received and planted in no way corresponded with the seasons kept by the main crop. They are said to be from wild plants. Those marked with a dagger are also being grown apart, as for various reasons they were planted two months earlier than the main crop.

*Upgrowing Yams.* The races of the upgrowing yams are few; and five are being retained in cultivation. It is believed that the Gardens numbers 38 and 72 scarcely differ; and of them No. 72 is being kept. Both yield more than the Nos. 28, 32 and 34. Number 28 yields the least of all five; and it is transitional towards the branched yams of the normal type. Number 32 and 34 are very similar to each other, the second however yielding rather more than the former.

All upgrowing yams appear to be good table yams; and all have magenta sap in the tissues.

| Gardens No. | Origin. | Name under which received. | Figured |
|---|---|---|---|
| 28 | Pilippines | Tumuktoh, No. 1095 | G.B. I No. 9 fig. 1 on p 301 and Nos. 11-12 pl. V. & II on i pl. ii |
| 32 | do. | Tinugue, No. 956 | G.B. I No. 9 fig. 3 on p. 301 |
| 34 | do. | Ballolong, No. 943 | G.B. I No. 9 fig. 4 on p. 301. |
| 72 | do. | Sinaway pulo, No. 955 | G.B. I Nos. 11-12 pl. vi & II No. 2 pl. iv. |

I. H. Burkill.

## IT NEEDS WANT TO MAKE PEOPLE CHANGE THEIR FOOD-HABITS.

It needs want to make people change their food-habits; so intensely conservative are we in such matters, with some reason, but also with all the prejudice that we can let play. The following paragraphs from the *Gardeners' Chronicle* of February 3rd, 1917, p. 53, on the passing away of a now forgotten prejudice against the potato, are quoted in illustration, and as being appropriate to the present time when the Malay Peninsula is faced with a shortage of rice which must compel a large part of the population to eat something unusual; and that they will resist doing. This is what is written in the *Gardeners' Chronicle.*

"Raleigh we are told at school, introduced the Potato from Carolina: but Raleigh never was in Carolina, nor does the Potato grow wild there, being a native of Peru where it was found by Pietro Cieza de Leon about 1532. This Spanish traveller followed Pizarro, whose conquest of Peru thus directly led to the introduction of the Potato into Europe.† Its welcome in Spain was not warm; for long it was but a curiosity; and it is said, with what truth we dare not say, that the Church frowned upon it seeing in it a competitor with the titheable wheat. In Italy its reception was hardly less cold; and as a food plant its spread on the Continent was everywhere slow.

Its introduction into Ireland is said by many writers to be due to Hawkins,* and if this be established, it seems probable that it was seized on one of his Spanish prizes. It soon became widely grown there, and thence spread to Lancashire, the first part of England to undertake its culture upon a large scale.

† The potato of Falstaff, it should be said, refers to a different plant altogether, a member of the Convolvulus family, whose edible tubers were grown and used when candied as a sweetmeat.

* John Hawkins, Elizabethan navigator, 1253—1595, born in the year of the discovery of the potato by Cieza de Leon.

In England it did not lack supporters, and in 1663† the Royal Society listened to a Mr. Buckland, who spoke long and warmly in its praises. How far this championship succeeded is doubtful. One witness tells us it was common in England in 1698, but a dozen contemporaries give him the lie." If I can't get bread, wrote Richardson in *Pamela* in the year 1740, I will live like a bird in winter upon hips and haws, and at other times upon pignuts and potatoes. The coupling of the potato with so mean a weed as the pignut ranks it very low, while admitting it among familiar country objects. "The general trend of evidence is that the Potato did not come into anything like general use until the distressful years that followed the victory of Waterloo.

Even then it did not lack detractors. Cobbett thundered against the "infamous vegetable" which with the use of tea would reduce the sturdy English labourer to the level of the Irish peasant. The Times in 1829 considered it as "a fit esculent to lower the food of the opulent" but its use among the working classes would lower them to "a nation of miserable turbulent drunkards." In France it was considered "le plus mauvais de tous les légumes dans l'opinion générale. Cependant le peuple qui est la partie la plus nombreuse de l'humanité s'en nourrit." This was written in 1779.

Parmentier,‡ whose name still figures on our menus when potato-soup requires disguising, succeeded in introducing it to higher circles, and even persuaded Louis XVI to wear its flower in his buttonhole.

In Scotland the dearth of 1740 led to its introduction, and here again it met with the usual opposition. "Tatties! tatties!" said one old native, "I ne'er supped on them a' my days, and and 170. These six are, No. 95 being the branched yam:—
winna the nicht." The more philosophical argued that potatoes were not mentioned in the Bible. However the tatties made themselves at home, and have kept many a scotchman from treading the broad road that leads to England.

Potatoes are now a habit." The potato plant has won through: and its cultivation has received not a little further stimulation in the calamity of the Great War. Its history preaches the fact that our food prejudices are enormous, and hard to break.

For some years an attempt has been made from the Botanic Gardens to popularise the use of tubers which are capable of being local substitutes for the potato, with scant success among those who can afford to have prejudices; but the repeated thefts from the crop show that the needy, who cannot afford to have many, will eat them. Unfortunately the needy being unable to propagate them, are merely destructive.

These tubers are certain yams, yautias, and what the French call crosnes,—all easy of digestion if properly cooked.

I. H. Burkill.

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† or close upon 100 years from its introduction into Ireland.

‡ Antoine Auguste Parmentier, 1737—1813.

## HOW TO PREPARE MAIZE FOR BREAD OR PUDDING.

Amongst suggestions for the preparation of locally-grown foodstuffs in a circular issued by the Acting Director of Agriculture, Trinidad, the following is worth drawing attention to: "To prepare Indian corn to get best results for several kinds of bread or pudding, it is best to take off the skin. This is done as follows: To 2 lbs. corn allow 2 lbs. sifted ashes and about one gallon water, and boil for one hour. It is sufficiently boiled when a grain squeezed between the fingers pulps out of the skin. Place the pot from the fire under a stream of cold water, and rub the corn with the hands when the skin will easily separate, and the overflow of water will carry away all the ashes and the skin. When clean, drain off the water, add about 1½ gallon clean water, and reboil for about fifteen minutes. The grains must then be crushed into a fine paste, either in a mill or a meat mincer." (Trop. Agriculturist, Ceylon, March, 1919, lii, p. 125).

## "PLANTS and SEEDS INWARDS" of the Botanic Gardens, Singapore.

The following table has a small historic interest; it is of the number of entries year by year in the "Plants inwards" books of the Botanic Gardens: each entry being the name of a plant indicating a receipt,—it may have been in the form of seed or of a plant or plants alive. From the figures we find that Murton upon his coming ran up the number of importations to 673 to fall again, but to be raised to 863 in 1879 as the result of the exchanges for orchids which he established. Cantley in his second year imported 718 and in 1887—his last—1490; Mr. Ridley's receipts average about five hundred annually.

| Years. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1875—1880 | — | — | — | — | 166 | 673 | 197 | 250 | 863 | 89 |
| 1881—1890 | 336 | 718 | 477 | 297 | 449 | 689 | 1490 | 488 | 897 | 1127 |
| 1891—1900 | 498 | 503 | 777 | 630 | 305 | 383 | 404 | 449 | 487 | 336 |
| 1901—1910 | 195 | 429 | 436 | 629 | 552 | 545 | 441 | 576 | 832 | 587 |
| 1911—1918 | 522 | 621 | 734 | 424 | 407 | 964 | 840 | 1052 | — | — |

**RAINFALL** at the Director's house, Botanic Gardens, Singapore during the first half of the year 1918, in inches.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours begin

| Date. | Jan. | Feb. | March. | April. | May. | June. |
|---|---|---|---|---|---|---|
| 1 | .01 | nil. | nil. | nil. | 2 08 | nil. |
| 2 | .02 | .09 | nil. | nil. | .05 | .01 |
| 3 | .08 | .03 | nil. | 1.78 | nil. | nil. |
| 4 | .18 | .02 | nil. | .29 | nil. | nil. |
| 5 | .49 | .08 | trace. | .66 | .08 | .84 |
| 6 | .22 | trace. | nil. | 1.30 | .01 | .10 |
| 7 | .27 | .39 | .21 | .04 | .05 | 1.71 |
| 8 | .59 | nil. | .03 | 1.47 | 1.05 | .79 |
| 9 | .48 | trace. | .73 | .05 | .98 | .13 |
| 10 | 4.62 | nil. | .07 | nil. | .18 | .13 |
| 11 | 5.42 | nil. | .23 | nil. | .10 | .07 |
| 12 | 6.07 | nil. | .68 | .09 | .73 | .53 |
| 13 | .03 | .09 | .11 | .02 | .32 | .01 |
| 14 | .29 | 1.03 | .06 | 1.44 | nil. | .19 |
| 15 | .77 | .13 | nil. | .02 | nil. | .27 |
| 16 | nil. | .12 | nil. | nil. | .30 | .02 |
| 17 | .14 | .08 | nil. | .52 | trace. | nil. |
| 18 | .12 | nil. | nil. | nil. | .05 | .24 |
| 19 | .05 | nil. | nil. | nil. | .20 | .02 |
| 20 | 1.33 | nil. | nil. | .02 | .01 | nil. |
| 21 | .80 | nil | nil. | 1.04 | .59 | 2.02 |
| 22 | .01 | nil. | nil. | .03 | .03 | .08 |
| 23 | .08 | trace. | nil. | .45 | 1.19 | trace. |
| 24 | .29 | .01 | nil. | trace. | .17 | 2.48 |
| 25 | nil. | nil. | trace. | .90 | nil. | .02 |
| 26 | nil. | nil. | nil. | trace. | nil. | 1.99 |
| 27 | nil. | nil. | nil. | .15 | nil. | nil. |
| 28 | nil. | nil. | nil. | .04 | nil. | nil. |
| 29 | .01 | | nil. | .43 | nil. | nil. |
| 30 | trace. | | trace. | nil. | .02 | .04 |
| 31 | nil. | | .04 | | .02 | |
| | 22.37 | 2.07 | 2.16 | 10.74 | 8.21 | 11.69 |

**RAINFALL** at the Director's house, Botanic Gardens Singapore during the second half of the year 1918, in inches.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours begin.

| Date. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|
| 1 | 1.15 | .01 | .11 | nil. | .06 | 1.88 |
| 2 | .02 | .01 | nil. | nil. | .50 | .02 |
| 3 | .17 | .11 | nil. | nil. | .01 | .18 |
| 4 | .09 | .03 | trace. | nil. | .02 | .02 |
| 5 | nil. | nil. | .11 | nil. | trace. | .02 |
| 6 | nil. | nil. | trace. | nil. | .01 | nil. |
| 7 | nil. | nil. | 2.21 | .02 | nil. | .01 |
| 8 | nil. | .23 | 2.18 | .01 | .76 | 2.18 |
| 9 | .03 | .04 | .01 | .01 | .03 | .01 |
| 10 | .61 | nil. | nil. | nil. | nil. | .03 |
| 11 | .02 | .46 | .05 | .46 | nil. | .01 |
| 12 | nil. | .07 | .16 | .01 | .14 | 1.27 |
| 13 | nil. | .02 | trace. | nil. | .02 | trace. |
| 14 | .02 | nil. | .32 | nil. | nil. | nil. |
| 15 | 1.21 | 1.07 | .02 | .79 | .70 | 1.14 |
| 16 | nil. | .46 | 1.62 | .06 | .07 | .29 |
| 17 | nil. | nil. | .02 | nil. | .08 | nil. |
| 18 | nil. | nil. | 1.30 | trace. | nil | nil. |
| 19 | nil. | nil. | nil. | .38 | .02 | .04 |
| 20 | .16 | nil. | nil. | nil. | .20 | nil. |
| 21 | .12 | nil. | .15 | nil. | 1.23 | nil. |
| 22 | nil. | nil. | .06 | nil. | .01 | .41 |
| 23 | nil. | nil. | nil. | nil. | .07 | .15 |
| 24 | nil. | 2.90 | .34 | .14 | .02 | nil. |
| 25 | .01 | .01 | .01 | .02 | .29 | .13 |
| 26 | nil. | nil. | nil. | .18 | .04 | .17 |
| 27 | nil. | nil. | nil. | 1.72 | .31 | .91 |
| 28 | trace. | .35 | .21 | .02 | .80 | .03 |
| 29 | .91 | nil. | nil. | 1.23 | .39 | .03 |
| 30 | .67 | nil. | nil. | 1.33 | .60 | .19 |
| 31 | .10 | trace. | | .01 | | nil. |
| | 5 29 | 5.77 | 8.88 | 6.39 | 6.38 | 9.12 |

**RAINFALL** at the head of the Waterfall Gardens, Penang during the first half of the year 1918, in inches.

Reading taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George Town, Penang.

| January. | | February. | | March. | | April. | | May. | | June. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date. | Inches. | Date. | Inches. | Date. | Inches. | Date. | Inches. | Date. | Inches. | Date. | Inches. |
| 1 | ... | 1 | ... | 1 | ... | 1 | 1.90 | 1 | .10 | 1 | 1.36 |
| 2 | ... | 2 | ... | 2 | 1.41 | 2 | .15 | 2 | ... | 2 | .04 |
| 3 | ... | 3 | ... | 3 | ... | 3 | ... | 3 | .37 | 3 | .87 |
| 4 | ... | 4 | ... | 4 | ... | 4 | 1.80 | 4 | .10 | 4 | .19 |
| 5 | .28 | 5 | ... | 5 | ... | 5 | ... | 5 | 1.74 | 5 | .20 |
| 6 | .08 | 6 | ... | 6 | ... | 6 | 1.07 | 6 | .03 | 6 | 2.18 |
| 7 | .08 | 7 | ... | 7 | ... | 7 | .16 | 7 | ... | 7 | .38 |
| 8 | ... | 8 | .12 | 8 | ... | 8 | ... | 8 | ... | 8 | ... |
| 9 | ... | 9 | ... | 9 | ... | 9 | .. | 9 | 1.24 | 9 | ... |
| 10 | ... | 10 | ... | 10 | ... | 10 | .21 | 10 | .17 | 10 | ... |
| 11 | ... | 11 | ... | 11 | ... | 11 | ... | 11 | ... | 11 | ... |
| 12 | .32 | 12 | .. | 12 | ... | 12 | .24 | 12 | ... | 12 | ... |
| 13 | .32 | 13 | ... | 13 | ... | 13 | .07 | 13 | .08 | 13 | .05 |
| 14 | .58 | 14 | ... | 14 | ... | 14 | .19 | 14 | 1 53 | 14 | .03 |
| 15 | .24 | 15 | ... | 15 | ... | 15 | 2.75 | 15 | .17 | 15 | .07 |
| 16 | ... | 16 | ... | 16 | ... | 16 | ... | 16 | 1.92 | 16 | ... |
| 17 | ... | 17 | ... | 17 | ... | 17 | .20 | 17 | 1.60 | 17 | |
| 18 | .03 | 18 | ... | 18 | ... | 18 | ... | 18 | .10 | 18 | 1.58 |
| 19 | ... | 19 | ... | 19 | ... | 19 | 1.10 | 19 | ... | 19 | .43 |
| 20 | ... | 20 | ... | 20 | ... | 20 | .14 | 20 | ... | 20 | ... |
| 21 | ... | 21 | | 21 | .. | 21 | .07 | 21 | .16 | 21 | .06 |
| 22 | ... | 22 | .. | 22 | .10 | 22 | .49 | 22 | .05 | 22 | ... |
| 23 | ... | 23 | ... | 23 | 05 | 23 | .36 | 23 | ... | 23 | 1.92 |
| 24 | ... | 24 | ... | 24 | ... | 24 | .12 | 24 | ... | 24 | 2.15 |
| 25 | ... | 25 | ... | 25 | ... | 25 | 1.05 | 25 | ... | 25 | 2.25 |
| 26 | ... | 26 | ... | 26 | ... | 26 | ... | 26 | ... | 26 | ... |
| 27 | ... | 27 | ... | 27 | ... | 27 | 1.42 | 27 | ... | 27 | ... |
| 28 | .72 | 28 | ... | 28 | ... | 28 | .09 | 28 | ... | 28 | .22 |
| 29 | .. | | | 29 | .08 | 29 | ... | 29 | .48 | 29 | ... |
| 30 | ... | | | 30 | 1.12 | 30 | 1.22 | 30 | .37 | 30 | 93 |
| 31 | ... | | | 31 | ... | | | 31 | ... | | |
| | 2.65 | | .12 | | 2.76 | | 14.80 | | 10.21 | | 14.91 |

**RAINFALL** at the head of the Waterfall Gardens, Penang during the second half of the year 1918, in inches.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin. Data kindly supplied by the Municipal Commissioners of George town, Penang.

| July. | | August. | | September. | | October. | | November. | | December. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date. | Inches. | Date. | Inches. | Date. | Inches. | Date. | Inches. | Date. | Inches. | Date. | Inches. |
| 1 | .28 | 1 | ... | 1 | ... | 1 | ... | 1 | .12 | 1 | .10 |
| 2 | ... | 2 | ... | 2 | ... | 2 | .03 | 2 | .10 | 2 | .19 |
| 3 | ... | 3 | ... | 3 | ... | 3 | 1.55 | 3 | 1.08 | 3 | .95 |
| 4 | ... | 4 | ... | 4 | .68 | 4 | 2.65 | 4 | .39 | 4 | .05 |
| 5 | ... | 5 | .24 | 5 | 2.42 | 5 | .17 | 5 | .19 | 5 | .16 |
| 6 | .04 | 6 | .02 | 6 | .14 | 6 | 2.30 | 6 | .19 | 6 | ... |
| 7 | ... | 7 | .62 | 7 | .60 | 7 | .11 | 7 | .25 | 7 | .03* |
| 8 | ... | 8 | ... | 8 | ... | 8 | .40 | 8 | .15 | 8 | 2.03 |
| 9 | ... | 9 | .23 | 9 | .72 | 9 | 2.08 | 9 | .79 | 9 | .. |
| 10 | ... | 10 | .09 | 10 | .24 | 10 | .69 | 10 | 1.31 | 10 | .05 |
| 11 | ... | 11 | .26 | 11 | 1.05 | 11 | .62 | 11 | ... | 11 | ... |
| 12 | .33 | 12 | .09 | 12 | .03 | 12 | .30 | 12 | ... | 12 | .66 |
| 13 | .08 | 13 | .72 | 13 | .06 | 13 | ... | 13 | 1.53 | 13 | .21 |
| 14 | 90 | 14 | .32 | 14 | .03 | 14 | .11 | 14 | .72 | 14 | ... |
| 15 | .15 | 15 | .87 | 15 | ... | 15 | .42 | 15 | 1.45 | 15 | ... |
| 16 | .13 | 16 | ... | 16 | ... | 16 | .75 | 16 | .82 | 16 | ... |
| 17 | .40 | 17 | ... | 17 | 1.76 | 17 | .37 | 17 | .12 | 17 | .. |
| 18 | .44 | 18 | .26 | 18 | 87 | 18 | .53 | 18 | ... | 18 | .16 |
| 19 | .83 | 19 | ... | 19 | ... | 19 | .13 | 19 | .22 | 19 | 1.30 |
| 20 | .38 | 20 | ... | 20 | 3.27 | 20 | 58 | 20 | 1.35 | 20 | .33 |
| 21 | .07 | 21 | ... | 21 | 1.47 | 21 | .26 | 21 | 1.18 | 21 | .10 |
| 22 | ... | 22 | .84 | 22 | .72 | 22 | ... | 22 | ... | 22 | .70 |
| 23 | ... | 23 | .39 | 23 | 1.30 | 23 | .44 | 23 | .12 | 23 | .09 |
| 24 | ... | 24 | ... | 24 | .47 | 24 | .24 | 24 | .03 | 24 | .29 |
| 25 | ... | 25 | 1.22 | 25 | .75 | 25 | .13 | 25 | .45 | 25 | ... |
| 26 | 1.25 | 26 | 1.64 | 26 | .54 | 26 | .29 | 26 | 16 | 26 | .06 |
| 27 | ... | 27 | .32 | 27 | .24 | 27 | .24 | 27 | ... | 27 | 1.03 |
| 28 | ... | 28 | ... | 28 | .. | 28 | .03 | 28 | ... | 28 | ... |
| 29 | .19 | 29 | ... | 29 | .. | 29 | 03 | 29 | ... | 29 | ... |
| 30 | .03 | 30 | .09 | 30 | .06 | 30 | .12 | 30 | 1.85 | 30 | ... |
| 31 | .34 | 31 | .32 | | | 31 | .08 | | | 31 | ... |
| | 5.84 | | 8.53 | | 17.42 | | 15 65 | | 14.57 | | 8.49 |

*More than 8 inches probably fell and by reason of some accident went unrecorded.

# SUMMARY OF RAINFALL.

| | SINGAPORE. | | | PENANG. | | |
|---|---|---|---|---|---|---|
| | No. of rainy days. | Amount of rain in inches. | Longest spell without rain. | No. of rainy days. | Amount of rain in inches. | Longest Spell without rain. |
| January - - | 25 | 22.37 | 4 | 9 | 2.65 | 9 |
| February - | 13 | 2.07 | 6 | 1 | 0.12 | 21 |
| March - - | 12 | 2.16 | 10 | 5 | 2.76 | 19 |
| April - - | 22 | 10.74 | 2 | 21 | 14.80 | 2 |
| May - - | 22 | 8.21 | 5 | 17 | 10.21 | 6 |
| June - - | 22 | 11.69 | 3 | 18 | 14.91 | 5 |
| July - - | 16 | 5 29 | 4 | 16 | 5.84 | 5 |
| August - - | 15 | 5.77 | 7 | 18 | 8.53 | 4 |
| September - | 20 | 8.88 | 2 | 21 | 17.42 | 3 |
| October - - | 17 | 6.39 | 8 | 28 | 15.65 | 1 |
| November - | 25 | 6 38 | 2 | 23 | 14.57 | 3 |
| December - | 23 | 9.12 | 2 | 19 | 8.49 | 4 |
| Total ... | 232 | 99.07 | —— | 196 | 115.95 | —— |

| | | | |
|---|---|---|---|
| Greatest amount in 24 hours ... | 6.07 | Uncertain, possibly 8.00 but recorded | 3.27 |
| ,, ,, 48 ,, ... | 11.49 | | 4.74 |
| ,, ,, 72 ,, ... | 16.11 | | 5.46 |
| Excessively rainy periods, more than 5.00 having fallen in 72 hours (January) | 1 | (Sept., Oct., Dec.) | 3 |
| No. of days when the condition on persisted. | 3 | | 3 |
| Periods of comparative drought less than 0 02 having fallen in 120 hours (January, February, March, May, August, October) | 7 | (Jan. 2, Feb , Mch. 2, May, June., July.) | 9 |
| Number of days when the condition existed. | 38 | | 45 |